



HORIZONTAL INCLINOMETER PROBE

User Manual



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Notes on the use of product



For a safe and efficient use of the instrument, please read carefully the following instructions before starting any operation.

Any use of the instrument other than the one described in this manual shall be considered at user's full responsibility.

The same applies for any unauthorized modifications.

In addition to the hereby listed standards, the user must comply with the provisions of the current legislation on the matter of personal safety and health of persons in the workplace.

SISGEO is not responsible for any trouble, breakdowns, accidents etc.. due to the lack of knowledge and/or confidence (or non-compliance with) with the requirements contained in this manual.

Check that the instrument has not been damaged during the transport.

Verify that the package includes all items as well as any requested optional accessories; if anything is missing, please promptly contact the manufacturer.

The user must strictly follow all the operations described in this manual.

Maintenance or repair of the instrument is allowed only to authorized operators.

These operators must be physically and intellectually suitable.

For information about instrument or order spare parts request, please always specify data written on the identification label.

When replacing parts, always use ORIGINAL SPARE PARTS.

The manufacturer reserves the right to make changes without prior notice for any technical or commercial requests.

We'll try anyway to keep the manuals updated in order to reflect product's revisions/updates.

Symbols

This symbol will be used used to catch reader's attention on the manual:



Pay special attention to the following instruction.

Identification

Instruments can be identified

- From a production lot number (written on the Compliance Certificate)
- From a serial number (*s/n*) engraved indelibly on the instrument
- From a label on the instrument
- From a label on the cable

Introduction

The horizontal inclinometer probes are used to measure settlements and vertical deformations.

They are used mainly in foundations, embankments and tanks.

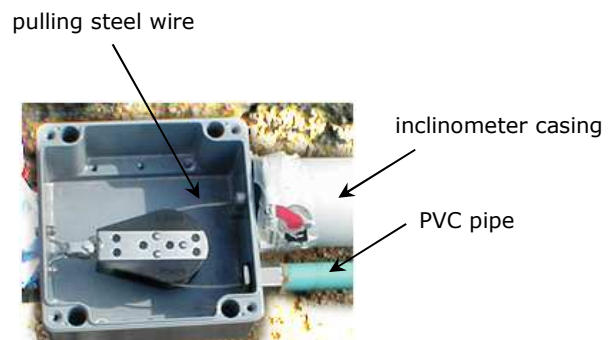
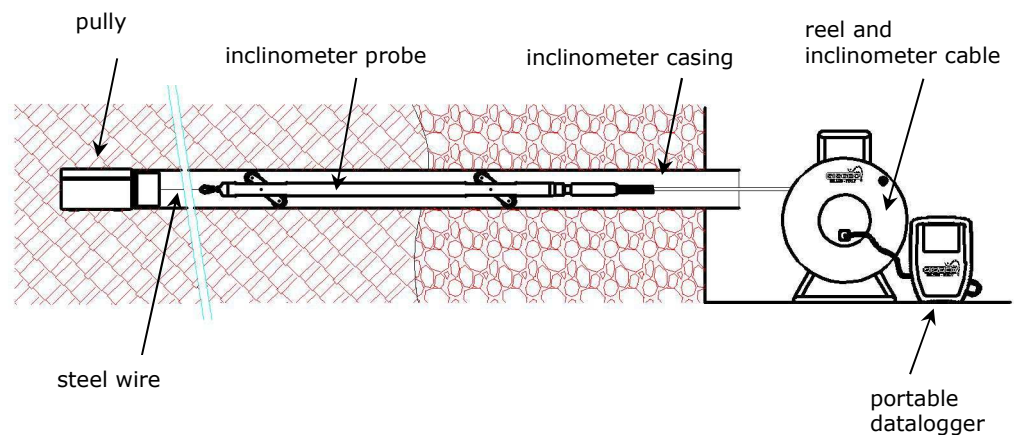
Inclinometer probe is a part of a system which includes:

- Horizontal inclinometer probe;
- Inclinometer cable;
- Portable Datalogger for data management;
- Incl2 data management software

Measurements are usually carried out moving the probe inside inclinometer casing (aluminum or ABS made).

The casing follows the deformations of the material where it is installed.

A pulley is required when one end of the casing is not accessible (open) in order to pull (move) the inclinometer probe inside the casing by means of a pulling steel wire.



Description

The horizontal inclinometer probe consists of a cylinder stainless steel body with digitized uniaxial MEMS tilt sensor.

Probe is equipped with:

- Two electrical connectors with O-Ring (1 and 2) at each ends;
- Two wheel assemblies 500mm apart, for guiding the probe through the grooves of the inclinometer casing.

The inclinometer operating cable supplied on reel mounts at one end the probe mating connector.

The cable has metal marks every 500mm.

The first mark is 1m far from the middle of the probe wheel assemblies.

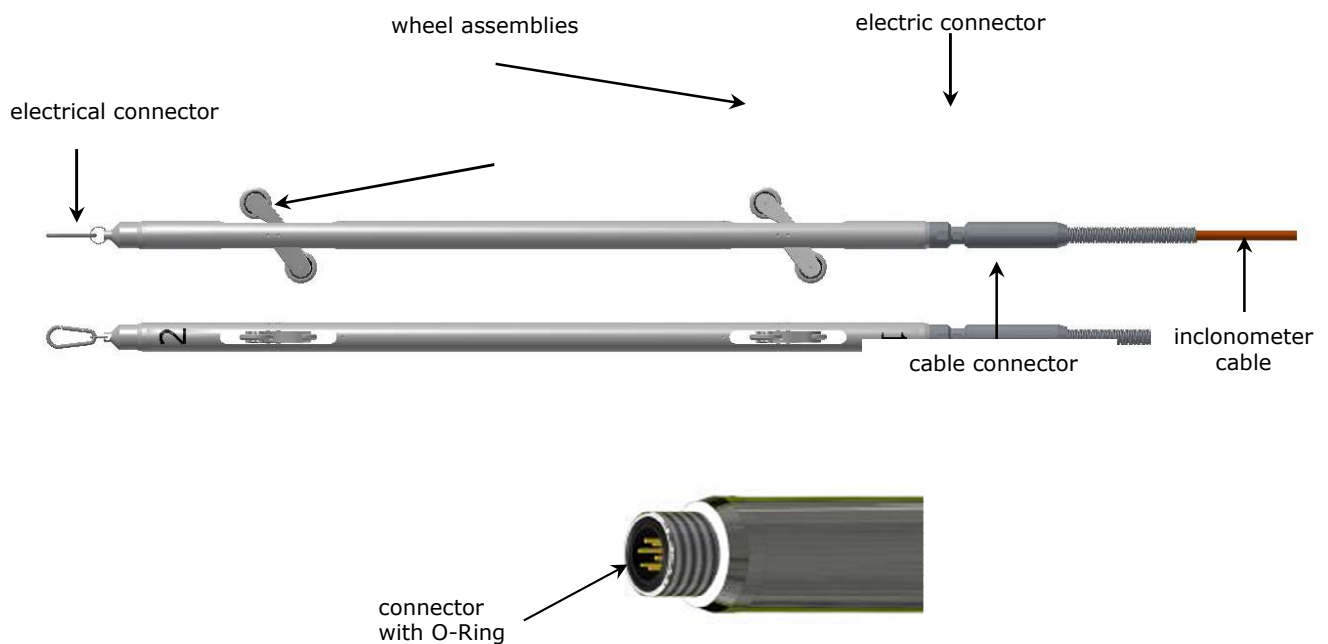
Every 5m a colored reference tape identifies the distance/position (see Appendix 2).

Yellow cable is suitable for both servo-accelerometer and MEMS digital probes.

It is reinforced with a stainless steel shield in order to avoid torsions and elongations.

Orange cable designed for the MEMS probe is lighter and easy to handle.

It has a kevlar stress member in order to avoid elongation.

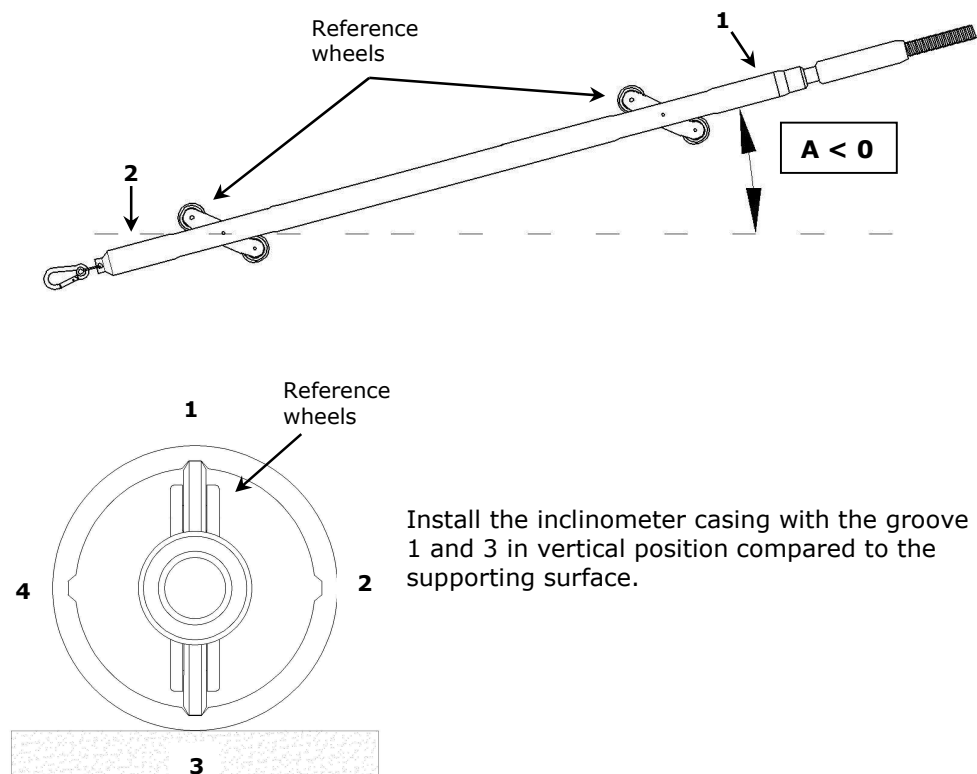


Taking measurements

The inclinometer reading consists in a survey, at regular steps, of the inclinometer casing tilt compared to the horizontal. The step is usually the same of the wheels assembly interaxis or a multiple.

The first reading, called "zero reading", is the reference reading compared to which all the displacements of the inclinometer casing will be calculated; the following readings are called "exercise readings".

The following drawing shows the convention:



To carry out inclinometer measurements proceed as follows:



- Remove the probe from the carrying bag;
- Check the wheels assembly and the wheels functionality;
- Check the O-ring;
- Keep the probe in vertical position on the ground and connect the inclinometer cable to the connector "1" paying attention to fit the connector references. DON'T TURN and DON'T STRAIN the connectors in order to avoid any irreparable damages;
- Once the connectors are matched, screw manually the nut until is fully locked. If well connected, the tightness is guaranteed up to 2MPa;
- Connect the steel wire to the steel cap on the connector "2";
- Put the probe into the inclinometer casing with the reference wheels in the groove no. 1.
- Position the probe at the end of the casing using the steel wire;
- Connect the datalogger to the inclinometer cable with the supplied connector. Be careful to respect the connectors polarity;



- Switch-on the datalogger and wait for 10-15 minutes until the temperature stabilization;
- Pull the probe until the first available mark is at the border of the inclinometer casing. Place very carefully the marks since, in order to have good results, their position must never change.
- Wait until the value stabilization, identified as A1, and record this value;
- Pull the probe, placing the next mark at the reference point according to the step set;
- Proceed in this way for the whole length of the casing;
- Once ended, pull out the probe from the casing and disconnect the moving wire;
- Disconnect the inclinometer cable from the connector "1" and connect it to the connector "2";
- Connect the steel wire to the steel cap and screw it on the connector "1";
- Put the probe into the inclinometer casing with reference wheels in the groove no. 1 and position it at the end of the casing using the steel wire.
- Proceed as already explained above. In this case the values will be identified as A3.
- Once ended the reading, disconnect the datalogger, unscrew the nut and disconnect the probe from the inclinometer cable;
- Check the connectors (probe and cable): be sure that there is no humidity inside;
- Screw the protection caps;
- Clean and dry the probe carefully;
- Put the probe in its carrying casing;
- Rewind carefully the inclinometer cable on the reel, avoiding any torsion.



Advices:



- Use always the same inclinometer system (probe-datalogger-cable) to survey the casing.
- Pay attention to the reference points (marks).
- Wait until the inclinometer system temperature is stable: it could be useful, in this case, to check the values shown by the datalogger.
- When you move from a quote to the next one, record the data only when the values are settled.
- In case of wrong positioning, put the probe at the previous position.
- Avoid pulls and excessive speed during the probe recovery.

Data processing

The data processing is usually made using a dedicated software (i.e. FIELD-SISGEO *INCL12*); see the reference manual for further details.

Herewith below are clarified the basic notions for data processing.

SISGEO inclinometer probes have a constant k of 20000.

Different k shall be required at order placing.

The values (digits) displayed from SISGEO dataloggers are:

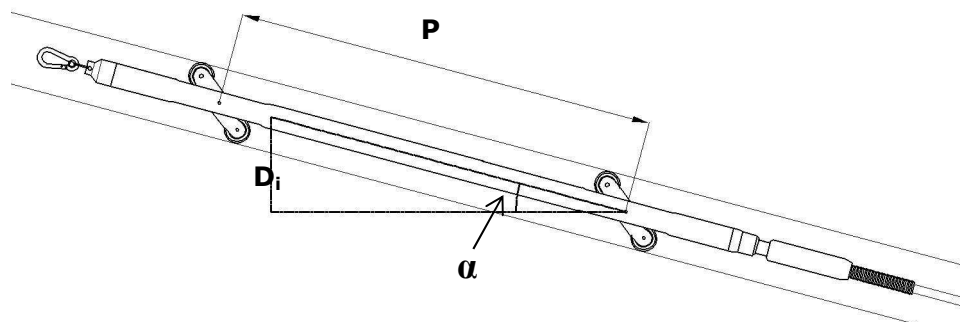
$$\text{digits} = (\sin\alpha) \times (k)$$

Example:

Ch. A: 698(digits)

$$\alpha = \arcsin (698/20000) = 2^\circ$$

To calculate the casing inclination at each quote proceed with the following formula:



$$D_i = P \times \sin\alpha$$

where

D_i = casing displacements at the generic quote

P = measurement step

$\sin\alpha$ = casing inclination angle at the generic quote

The inclination value for each measuring step is: $(A1-A3)/2$

Example:

At "i" quote we have the following values:

$A1 = 480$

$A3 = -506$

$P = 500\text{mm}$

The inclination at the "i" quote is 12.325mm

To calculate the global displacement D of the casing proceed with the following formula:

$$D = \sum_1^n D_i$$

The global displacement calculation must be done considering that one of the end of the casing is not subject to movements or considering the absolute displacements of the casing taken, for example, by means of topographic measurements.

Hints on checksum

The checksum is the algebraic half-sum of the measurements obtained on the matched grooves 1-3.

It's like an electric and/or mechanic "offset" of the inclinometer probe and, as shown in the following example, does not affect the final result: it is a sign of the well-functioning of the inclinometer system and its regular check is important.

The checksum can be affected by deposits in the grooves, by inclinometer casing dents or ovalization, from the wheel positioning near the couplings and also by the differences between different models of Dataloggers.

Checksum value can change in time but, if the variation is not sudden, usually there is nothing to worry and is not necessary to contact SISGEO for technical assistance.

Anyway SISGEO suggests a check of the inclinometer system in case of checksum values higher than 25.

Example:

inclination 2° , theoretical value =698 (digits) , A1= 713, A3=-683

checksum= (A1+A3)/2= 15

A1-checksum= 713-15=698; A3-checksum= -698-15=-698

Anyway, the value obtained by the matching measures at the end of the processing is:

Am= (A1-A3)/2= [713-(-683)]/2 = 698

Maintenance

Probe maintenance



The inclinometer probe is a precision instrument and has to be handled carefully, avoiding accidental shocks both during the transport and the use.

Use the carrying case during the transport and the storage.

Clean the probe with water and lubricate the wheels and the springs without using grease.

Clean up the possible mud and dirt on the springs.

Take away the protection cap from the probe and inclinometer cable, clean and eventually dry the connector and the thread.

Clean the connectors with cotton wads and alcohol.

Don't use solvents or other products that can cause a damage.

The probe and the accessories must be stored in a dry place.

To avoid condensation we advise to store probe and cable without protection caps; they have to be put back on in case the instrument has to be moved.

Clean the inclinometer cable with water and dry it.

Be careful during the unwind and rewind of the cable in order to avoid stretching and rolling that can damage the cable.

When they are not in use, always protect the connectors with their caps.

To keep the system in perfect conditions we advise a maintenance check in our laboratories once a year.

Troubleshooting

Problem	Possible cause	Solution
Wrong measures	Wrong choice of the reference	Use the correct reference groove
Instable measures	Low battery voltage	Check the voltage on the display and put in charge (see the manual)
	Low insulation	Measure the insulation between the pins of the probe connector and the steel body. If it's less than 50 MΩ, send it back to SISGEO Assistance
	Damp in the connector	Dry it. Verify the integrity of the "O-ring"
	One or more electric wires are disconnected	Verify wiring in the Appendix 1. Send back to SISGEO Assistance if any disconnection is found.
Checksum values unsteady	Excessive movement of the wheels	Verify wheels movement. If necessary send back to SISGEO Assistance.
	Wheels out of grooves	Verify and insert correctly the wheels in the grooves. Move the probe more slowly.
	Dirty casing	Clean the casing

**Maintenance
service**

After-sales assistance on SISGEO products for calibrations, maintenance and repairs is performed by SISGEO service department.

The authorization of shipment shall be activated by RMA "Return Manufacturer Authorization". Fill in the RMA module clicking on:

<http://www.sisgeo.com/en/assistance/repairs/>

Send back the instrument/equipment with the complete accessories, using suitable packaging or, even better, the original ones.

The shipping costs shall be covered by the sender.

Please send the goods to the following address with suitable delivery document:

SISGEO S.r.l.
Via F.Serpero, 4/F1
20060 MASATE (MI)

On the delivery note is mandatory to indicate the received RMA code.

Technical assistance e-mail: assistance@sisgeo.com



Appendix 1

CONNECTION TABLE

MEMS DIGITAL PROBE				
Probe	Functions	Inclinometer cable (orange)		
		Conn. 6 pins Female	Color	Conn. 7 pins Male Panel
A	+Vcc	A	RED	A
B	-Vcc	B	BLACK	C
C	N.C.			
D	N.C.			
E	RS485 A	E	WHITE	E
F	RS485 B	F	GREEN	F

Universal inclinometer cable (yellow)		
Conn. 6 pins Female	Color	Conn. 7 pins Male Panel
A	ORANGE	A
B	GREY	C
C	BLACK	B
D	YELLOW	D
E	BLUE	E
F	GREEN	F
	SHIELD	G

FLYING CABLE MOD. ECAV07V2	
Female Connector (at the cable pulley)	Male Connector (to Datalogger)
A	A
B	B
C	C
D	D
E	E
F	F
G	G

Appendice 2**REFERENCE MARKS**

METERS	GREEN	BLACK	RED	WHITE
5	1			
10		1		
15	1	1		
20			1	
25	1		1	
30		1	1	
35	1	1	1	
40			2	
45	1		2	
50				1
55	1			1
60		1		1
65	1	1		1
70			1	1
75	1		1	1
80		1	1	1
85	1	1	1	1
90			2	1
95	1		2	1
100				2
105	1			2
110		1		2
115	1	1		2
120			1	2
125	1		1	2
130		1	1	2
135	1	1	1	2
140			2	2
145	1		2	2
150				3
155	1			3
160		1		3
165	1	1		3
170			1	3
175	1		1	3
180		1	1	3
185	1	1	1	3
190			2	3
195	1		2	3
200				4